



CITY OF SANTA BARBARA

ORDINANCE COMMITTEE AGENDA REPORT

AGENDA DATE: November 16, 2010

TO: Ordinance Committee

FROM: Building & Safety Division, Community Development Department

SUBJECT: Reach Code - Energy Efficiency Standards

RECOMMENDATION:

That the Ordinance Committee review and recommend for approval to the City Council an ordinance establishing local energy efficiency standards for new construction and most additions.

DISCUSSION:

On September 28, 2010, City Council received a presentation from the Southern California Edison Company regarding a South Coast Energy Reach Code proposal. The Energy Reach Code proposal would require new buildings and most additions to be 15 percent more energy-efficient than the current 2008 California Energy Code.

After receiving this presentation, Council voted to direct staff to conduct public outreach and prepare ordinance amendments for a South Coast Energy Reach Code for consideration by the City's Ordinance Committee.

The newly proposed Reach Code - Energy Efficiency Standards Ordinance (Energy Ordinance), which is based on the current 2008 California Energy Code deletes Chapter 22.82 of the City's Municipal Code and replaces the previously adopted Architecture 2030 Energy Efficiency Standards Ordinances, which were based on the now outdated 2005 California Energy Code.

The Draft Energy Ordinance has been placed on the City's website for public viewing and comment. Additionally, the Draft Energy Ordinance has been placed on the Land Development Team public bulletin, the Santa Barbara Contractors Association, American Institutes of Architects, and the Community Environmental Council's email notification list.

A public meeting was held Friday, October 22, 2010 to share and discuss the Draft Energy Ordinance. Representatives of the Southern California Edison Company; the Southern California Gas Company; and Mr. Mike Gabel, Energy Consultant, were in attendance. Mr. Gabel provided an overview of the Energy Ordinance followed by questions and answers.

The proposed Energy Ordinance is supported by our local American Institute of Architects, the Santa Barbara Contractors Association, the Community Environmental Council and many other local supporters.

Should the City's Ordinance Committee recommend for approval to the City Council the Reach Code – Energy Efficiency Standards Ordinance (Energy Ordinance) and City Council subsequently approve this Ordinance; an Energy Cost-Effectiveness Study for Climate Zone 6 that has been prepared and funded by the Southern California Edison Company will be forwarded to the California Energy Commission for review and approval. Once the Energy Cost-Effectiveness Study is approved by California Energy Commission the Energy Ordinance and the Energy Cost-Effectiveness Study would be brought back to Council for formal adoption.

Depending on the length of time taken to review and approve the Reach Code - Energy Efficiency Standards Ordinance (Energy Ordinance) by the California Energy Commission, it is anticipated that the new Ordinance would become effective in late February/March of 2011.

SUSTAINABILITY IMPACT

Adoption of this Ordinance would lead to stringent energy requirements for new construction and most additions than approved by the California Energy Commission. More energy efficient buildings will provide for the reduction and use of natural gas and electricity and may contribute to the reduction of greenhouse gas emissions from that construction.

ENVIRONMENTAL REVIEW

Staff has determined that the proposed Ordinance is categorically exempt from the California Environmental Quality Act (CEQA) review since it preserves and enhances the environment by setting forth minimum energy efficiency standards. In accordance with CEQA Guidelines Section 15308, actions authorized by State or local ordinance to assure the maintenance, restoration, enhancement, or protection of the environment are exempt from CEQA.

ATTACHMENTS:

1. Draft Reach Code – Energy Efficiency Standards Ordinance
2. Climate Zone 6 Energy Cost-Efficiency Study

PREPARED BY: George A. Estrella, Chief Building Official

SUBMITTED BY: Paul Casey, Assistant City Administrator

APPROVED BY: City Administrator's Office

**ORDINANCE COMMITTEE DISCUSSION DRAFT 11/16/10
SHOWING CHANGES FROM THE
FORMER MUNICIPAL CODE CHAPTER 22.82**

ORDINANCE NO. _____

**AN ORDINANCE OF THE CITY COUNCIL OF THE
CITY OF CITY OF SANTA BARBARA REPEALING
CHAPTER 22.82 OF THE SANTA BARBARA
MUNICIPAL CODE AND ENACTING A NEW
CHAPTER 22.82 ESTABLISHING LOCAL ENERGY
EFFICIENCY STANDARDS FOR CERTAIN
BUILDINGS AND IMPROVEMENTS COVERED BY
THE 2008 CALIFORNIA BUILDING ENERGY
EFFICIENCY STANDARDS.**

The City Council of the City of Santa Barbara does ordain as follows:

SECTION 1. Findings.

1. The modifications to the 2008 California Building Energy Efficiency Standards required by this ordinance are reasonably necessary due to local climatic conditions. Despite moderate summer ambient temperatures in the local area, the City of Santa Barbara is served by an energy system that may experience power outages or power reductions (i.e., “brown-outs”) during peak demand periods. Reduction of total and peak energy use as a result of incremental energy conservation measures required by this ordinance will have local and regional benefits in the cost-effective reduction of energy costs for the building owner, additional available system energy capacity, and a reduction in greenhouse gas emissions.

2. The proposed ordinance preserves and enhances the environment; in that it would set forth increased minimum energy efficiency standards within the City of Santa Barbara for buildings and improvements covered by the ordinance. In accordance with CEQA Section 15061(b)(3), “[C]EQA applies only to projects, which have the potential for causing a significant effect on the environment. Where it can be seen with certainty that there is no possibility that the activity in question may have a significant effect on the environment, the activity is not subject to CEQA.” Staff has determined that the proposed ordinance is exempt from CEQA review.

3. In order to maintain and advance the energy efficiency standards, it is in the best interest of the City to revisit this ordinance prior to expiration, ensuring that local energy standards meet the goals of reducing energy consumption, thereby saving on energy bills and decreasing greenhouse gas emissions.

4. The City has reviewed a study of the cost-effectiveness of the energy efficiency measures contained in this ordinance for the Climate Zones within the City’s jurisdiction. This study has concluded that the energy efficiency measures contained in this ordinance are cost-effective. The City Council hereby adopts the conclusions of this study and authorizes its inclusion in an

application for consideration by the California Energy Commission in compliance with Public Resources Code 25402.1(h)(2).

SECTION 2. Chapter 22.82 of the Santa Barbara Municipal Code, titled “Energy Efficiency Standards is hereby repealed and a new Chapter 22.82 is enacted to read as follows:

22.82.010 Purpose.

This Chapter (“Energy Efficiency Standards”) sets forth increased minimum energy efficiency standards within the City of Santa Barbara for all new construction of any size, additions to existing buildings or structures over a certain size threshold, and the installation of new ~~heaters or~~ circulation pumps for swimming pools, spas and water features. This Chapter is intended to supplement the ~~2005~~2008 California Building Energy Efficiency Standards, as specified in California Code of Regulations, Title 24, Parts 1 and 6 (Standards). Compliance with the ~~2005~~2008 California Building Energy Efficiency Standards is required even if the increased minimum energy efficiency standards specified in this Chapter do not apply.

22.82.020 Definitions.

For purposes of this Chapter 22.82, words or phrases used in this Chapter that are specifically defined in Parts 1, 2, or 6 of Title 24 of the California Code of Regulations shall have the same meaning as given in the Code of Regulations. In addition, the following words and phrases shall have the meanings indicated, unless context or usage clearly requires a different meaning:

A. **~~2005~~2008 BUILDING ENERGY EFFICIENCY STANDARDS.** The standards and regulations adopted by the California Energy Commission contained in Parts 1 and 6 of Title 24 of the California Code of Regulations as such standards and regulations may be amended from time to time.

B. **EXISTING + ADDITION + ALTERATION.** An approach to modeling the TDV (time dependent valuation) energy use of an addition including the existing building and alterations as specified in the Residential Compliance Manual and Nonresidential Compliance Manual.

C. **NONRESIDENTIAL COMPLIANCE MANUAL.** The manual developed by the California Energy Commission, under Section 25402.1(e) of the Public Resources Code, to aid designers, builders, and contractors in meeting the requirements of the state’s ~~2005~~2008 Building Energy Efficiency Standards for nonresidential, high-rise residential, and hotel/motel buildings.

~~———— D. **PHOTOVOLTAIC CREDIT.** A TDV Energy credit that may be used under certain conditions to demonstrate compliance with the City’s general compliance requirements as specified in Section 22.82.070. This credit is available if the solar photovoltaic energy system is capable of generating electricity from sunlight, supplying the electricity directly to the building, and the system is connected, through a reversible meter, to the utility grid. The methodology used to~~

calculate the time dependent valuation energy equivalent to the photovoltaic credit shall be the CECPV Calculator Version 2.1 or higher which may be found at the following web site:
http://www.gosolarecalifornia.ca.gov/nshpecalculator/download_calculator.html

D. **RESIDENTIAL COMPLIANCE MANUAL.** The manual developed by the California Energy Commission, under Section 25402.1(e) of the Public Resources Code, to aid designers, builders, and contractors in meeting the requirements of the state's ~~2005~~2008 Building Energy Efficiency Standards for low-rise residential buildings.

~~—— F. **SOLAR PHOTOVOLTAIC ENERGY SYSTEM.** A photovoltaic solar collector or other photovoltaic solar energy device that has a primary purpose of providing for the collection and distribution of solar energy for the generation of alternating current rated peak electricity. The installation of any solar photovoltaic energy system must meet all installation criteria of the current edition of the California Electrical Code and the California Energy Commission's Guidebook "Eligibility Criteria and Conditions for Incentives for Solar Energy Systems Senate Bill 1".~~

E. **SWIMMING POOL.** Any structure intended to contain water over 18 inches deep.

F. **TIME DEPENDENT VALUATION ENERGY or ("TDV ENERGY").** The time varying energy caused to be used by the building or addition to provide space conditioning and water heating and, for specified buildings, lighting. TDV energy accounts for the energy used at the building site and consumed in producing and in delivering energy to a site, including, but not limited to, power generation, transmission and distribution losses. TDV Energy is expressed in terms of thousands of British thermal units per square foot per year (kBtu/sq.ft.-yr).

G. **WATER FEATURE.** Any structure intended to contain water over 18 inches deep. Examples of water features include, but are not limited to, ponds and fountains.

22.82.030 Applicability.

A. The provisions of this Chapter apply to any of the following buildings or improvements for which a building permit is required by this Code:

1. Any new building or structure of any size,
2. Any addition to an existing low-rise residential building or structure where the addition is greater than 100 square feet of conditioned floor area,
3. Any addition to an existing nonresidential, high-rise residential or hotel/motel building or structure where the addition is greater than 100 square feet of conditioned floor area,
34. Indoor lighting alterations in conditioned spaces greater than ~~400~~500 square feet of floor area within nonresidential buildings,
45. All new ~~heaters or~~ circulation pumps for swimming pools, spas, and water features.

B. Subject to the limitations specified in this Section 22.82.030, the coverage of this Chapter shall be determined in accordance with the scope and application section of either the Residential Compliance Manual or Nonresidential Compliance Manual, as appropriate for the proposed occupancy.

22.82.040 Compliance.

A building permit application subject to the requirements of this Chapter will not be issued a building permit by the Building Official unless the energy compliance documentation submitted with the permit application complies with the requirements of this Chapter. A final inspection for a building permit subject to the requirements of this Chapter will not be approved unless the work authorized by the building permit has been constructed in accordance with the approved plans, conditions of approvals, and requirements of this Chapter.

22.82.050 Mandatory Energy Efficiency Requirements.

In addition to meeting all requirements of ~~2005~~2008 Building Energy Efficiency Standards, all applications for building permits that include buildings or improvements covered by this Chapter shall include the following mandatory energy efficiency measures as may be applicable to the proposed building or improvement:

A. **RESIDENTIAL BUILDINGS.** Unless preempted by the National Appliance Energy Conservation Act (NAECA), Any appliance (excluding HVAC equipment and water heaters) to be installed in a residential building shall be Energy Star rated, if the appliance installed is of a type that is Energy Star rated.

B. **SWIMMING POOL AND SPA HEATER PUMPS.** Any ~~heater or~~ circulation pump to be installed for any swimming pool, spa, or water feature shall incorporate the following energy conservation feature:

1. ~~1. All natural gas heaters shall have an annual fuel utilization efficiency of 90% or higher; and~~

2. ~~2. All circulating pump motors and filtration pump motors with a nominal rating of 0.75 horsepower or greater (except pump motors only serving spa jets) shall be two-speed or variable speed motors. The installation of all two-speed and variable speed motors shall include the installation of a controller which shall be time-based and shall be programmed to alternate the speed of the motor between low and high to make effective use of the energy savings potential of the unit's multi-speed capability.~~

C. ~~**MECHANICAL HEATING OR COOLING SYSTEMS.** All fan motors and pump motors associated with mechanical heating or cooling systems that are single speed, poly-phase, 1.0 nominal horsepower to 500 nominal horsepower, 2, 4, and 6 pole squirrel cage induction, NEMA Design A or B, continuous duty rated motors must be NEMA Premium motors by the National Electrical Manufacturers Association.~~

22.82.060 General Compliance Requirements.

In addition to any applicable mandatory requirements specified in Section 22.82.050 and the requirements of the ~~2005~~2008 Building Energy Efficiency Standards, the following general compliance requirements shall apply to permit applications subject to this Chapter as follows:

A. **LOW-RISE RESIDENTIAL BUILDINGS.** Applications for building permits that involve new low-rise residential buildings or additions to existing low-rise residential buildings where the additions are greater than 100 square feet of conditioned floor area shall demonstrate compliance with the general compliance requirements as follows:

1. **New Low-Rise Residential Buildings.** When an application for a building permit involves a new low-rise residential building, the performance approach specified in Section 151 of the ~~2005~~2008 Building Energy Efficiency Standards must be used to demonstrate that the TDV Energy of the proposed building is at least ~~20.0%~~15.0% less than the TDV Energy of the standard building.

2. **Additions to Low-Rise Residential Buildings.** When an application for a building permit involves an addition to an existing low-rise residential building, this general compliance requirement may be met by either of the following methods:

a. Using the performance approach specified in Section 151 of the ~~2005~~2008 Building Energy Efficiency Standards to demonstrate that the TDV Energy of the proposed addition is at least ~~20.0%~~15.0% less than the TDV Energy of the standard design; or,

b. Using the “Existing+Addition +Alteration” calculation methodology to demonstrate that the TDV Energy of the proposed building is at least ~~20.0%~~15.0% less than the TDV Energy of the standard design, as calculated in accordance with the performance approach specified in Section 151 of the ~~2005~~2008 Building Energy Efficiency Standards. In modeling buildings under the Existing+Addition+Alteration method, domestic hot water energy use must be included in the calculation model unless the application does not involve a change to the building’s existing water heater(s).

B. **HIGH-RISE RESIDENTIAL BUILDINGS & HOTEL/MOTEL GUEST ROOMS.** Applications for building permits that involve new high-rise residential buildings or hotel/motel guest rooms, or additions to these occupancies, where the additions are greater than 100 square feet of conditioned floor area, shall demonstrate compliance with the general compliance requirements as follows:

1. **New High-Rise Residential Buildings and Hotel/Motel Guest Rooms.** When an application for a building permit involves a new high-rise residential building or new hotel/motel guest rooms, the applicant shall use ~~either the Prescriptive Approach or the Performance Approach to demonstrate compliance as specified below:~~

~~a. **Prescriptive Approach.** If the building permit applicant chooses the prescriptive approach, the applicant shall use the Overall Envelope Approach in specified in Section 143(b) of the 2005 Building Energy Efficiency Standards to demonstrate that the Overall Heat Gain of the proposed building is at least 10.0% less than the Overall Heat Gain of the standard building; and the Overall Heat Loss of the proposed building is at least 10.0% less than the Overall Heat Loss of the standard building.~~

~~_____ b. **Performance Approach.** If the applicant chooses the performance approach, the applicant shall select one of the following energy budget calculation methodologies to demonstrate compliance with the general compliance requirements:~~

~~_____ (1) **Building Envelope Only.** Model the building envelope only using a state approved energy compliance software program and demonstrate that the TDV Energy of the sum of the Space Heating, Space Cooling and Indoor Fans energy components of the proposed building is at least 15.0% less than the TDV Energy of the sum of the Space Heating, Space Cooling and Indoor Fans energy components of the standard building; or,~~

~~_____ (2) **Building Envelope and Mechanical System.** Model the building envelope and mechanical system using a state approved energy compliance software program and demonstrate that the TDV Energy of the sum of the Space Heating, Space Cooling, Indoor Fans, Pump and Heat Rejection energy components of the proposed building is at least 15.0% less than the TDV Energy of the sum of the Space Heating, Space Cooling, Indoor Fans, Pump and Heat Rejection energy components of the standard building.~~ the Performance Approach to model the building using a state-approved energy compliance software program and demonstrate that the TDV Energy of the proposed building is at least 15.0% less than the TDV Energy of the standard building. In calculating the %-better-than-Title-24 in High-rise Residential or hotel/motel guest room projects, the TDV energy of the Process, Receptacle energy use components, and also lighting energy use in the residential spaces, is omitted in both the proposed and standard designs.

2. **Additions to High-Rise Residential Buildings and Hotel/Motel Guest Rooms.** When an application for a building permit involves an addition to an existing high-rise residential building or hotel/motel guest room occupancy, this general compliance requirement may be met by either of the following methods:

a. ~~Using the performance approach specified in Section 151 of the 2005 Building Energy Efficiency Standards to demonstrate that the TDV Energy of the proposed addition is at least 15.0% less than the TDV Energy of the standard design, or~~ Use the “Addition Alone” performance method specified in Section 22.82.060.B.1 to demonstrate that the TDV Energy sum of the energy components for the proposed addition is at least 15.0% less than the TDV Energy sum of the same energy components of the standard addition; or,

b. ~~Using~~ the “Existing+Addition +Alteration” calculation method specified in Section 22.82.060.B.1 to demonstrate that the TDV Energy for the sum of the energy components for the proposed building ~~specified in either b(1) or b(2) above~~ is at least ~~15.0%~~ 10.0% less than the TDV Energy for the sum of the same energy components of the standard design.

C. **~~NONRESIDENTIAL AND HOTEL/MOTEL OCCUPANCIES.~~** Applications for building permits that involve new nonresidential ~~buildings or hotel/motel~~ occupancies or additions to existing nonresidential ~~buildings or hotel/motel~~ occupancies where the additions are greater than 100 square feet of conditioned floor area shall demonstrate compliance with the general compliance requirements as follows:

1. **New Nonresidential Buildings or Hotel/Motel Occupancies.** When an application for a building permit involves a new nonresidential building ~~or a new building housing a hotel/motel occupancy~~, compliance with meeting the general compliance requirements established by this Chapter may be demonstrated by using either the prescriptive approach or performance approach as specified below:

a. **Prescriptive Approach.** Subject to the exceptions listed below and the provisions of the ~~2005~~2008 Building Energy Efficiency Standards, the prescriptive approach requires compliance with the prescriptive envelope requirement and/or the prescriptive indoor lighting requirement, depending upon the work proposed in the permit application, as specified below:

(1) **Prescriptive Envelopement Requirement.** The Overall Envelope TDV Energy Approach in Section 143(b) of the ~~2005~~2008 Building Energy Efficiency Standards shall be used to demonstrate that ~~the Overall Heat Gain of the proposed building is at least 10.0% less than the Overall Heat Gain of the standard building; and the Overall Heat Loss of the proposed building is at least 10.0% less than the Overall Heat Loss of the standard building~~ the Overall TDV energy of the proposed building is at least 10.0% less than the Overall TDV energy of the standard building; and/or,

(2) **Prescriptive Indoor Lighting Requirement.** The “Prescriptive Requirements for Indoor Lighting” contained in Section 146 of the ~~2005~~2008 Building Energy Efficiency Standards that apply to conditioned spaces shall be used to demonstrate that the Adjusted Actual (Installed) Watts are at least 10.0% less than the Total Allowed Watts.

(i) **Tailored Method Exception.** When using the Tailored Method in retail stores to determine compliance with the prescriptive requirements for indoor lighting, Display Lighting watts may be omitted from the above calculation.

(ii) **Small Alterations Exception.** Lighting alterations which encompass a gross conditioned floor area equal to or less than 100 square feet are exempt from the prescriptive indoor lighting requirement.

b. **Performance Approach.** ~~When using~~If the applicant chooses the performance approach to demonstrate compliance with the general compliance requirements, the permit applicant shall ~~select one of the following energy budget calculation methodologies:~~

~~(1) **Building Envelope Only.** Model the building envelope only for compliance using a state-approved energy compliance software program and demonstrate that the TDV Energy of the sum of the Space Heating, Space Cooling and Indoor Fans energy components of the proposed building is at least 10.0% less than the TDV Energy of the sum of the Space Heating, Space Cooling and Indoor Fans energy components of the standard building; or,~~

~~(2) **Building Envelope and Mechanical System.** Model the building envelope and mechanical system for compliance using a state-approved energy compliance software program and demonstrate that the TDV Energy of the sum of the Space Heating, Space Cooling, Indoor Fans, Pump and Heat Rejection energy components of the proposed building is at least 10.0% less than the TDV Energy of the sum of the Space Heating, Space Cooling, Indoor Fans, Pump and Heat Rejection energy components for the standard building; or,~~

~~(3) **Building Envelope and Lighting.** Model the building envelope and lighting for compliance using a state-approved energy compliance software program and demonstrate that the TDV Energy of the sum of the Space Heating, Space Cooling, Indoor Fans and Lighting energy components of the proposed building is at least 10.0% less than the TDV Energy of the sum of the Space Heating, the Space Cooling, Indoor Fans and Lighting energy components of the standard building; or,~~

~~(4) **Building Envelope, Lighting, and Mechanical System.**~~

~~Model the building envelope, lighting and mechanical system for compliance using a state-approved energy compliance software program and demonstrate that the TDV Energy of the sum of the Space Heating, Space Cooling, Lighting, Indoor Fans, Pump and Heat Rejection energy components of the proposed building is at least 10.0% less than the TDV Energy of the sum of the Space Heating, Space Cooling, Lighting, Indoor Fans, Pump and Heat Rejection energy components of the standard building.~~

model the building using a state-approved energy compliance software program and demonstrate that the TDV Energy of the proposed building is at least 15.0% less than the TDV Energy of the standard building. In calculating the %-better-than-Title-24, the TDV energy of the Process and Receptacle energy use components is omitted in both the proposed and standard designs.

2. Additions to Existing Nonresidential Buildings or Hotel/Motel

Occupancies. When an application for a building permit involves an addition to an existing nonresidential building ~~or an existing building housing a hotel/motel occupancy~~, this general compliance requirement may be met by either of the following methods:

a. ~~Using one of the performance approach methodologies specified above in subparagraph 1.b above, Use the “Addition Alone” performance method specified in Section 22.82.060.C.1.b to demonstrate that the TDV Energy sum of the energy components for the proposed addition specified in B.1.a(1) above is at least 10.0% less than the TDV Energy sum of the same energy components of the standard design addition; or,~~

b. ~~Using the “Existing+Addition +Alteration” calculation performance method specified in Section 22.82.060.C.1.b to demonstrate that the TDV Energy of the sum of the energy components for the proposed building specified in B.1.a(1) above is at least 10.0% less than the TDV Energy of the sum of the same energy components of the standard design.~~

D. DOCUMENTATION. In order to demonstrate compliance with the requirements of this Section, a permit applicant may be required to submit supplementary forms and documentation in addition to the building drawings, specifications, and standard Title 24 report forms, as deemed appropriate by the Building Official.

~~22.82.070 Credit for Solar Photovoltaic Energy Systems.~~

~~A. **NOT ALLOWED TO DEMONSTRATE COMPLIANCE WITH STATE STANDARDS.** A photovoltaic TDV Energy credit shall not be used to demonstrate compliance with the 2005 Building Energy Efficiency Standards.~~

~~B. **CREDIT ALLOWED TO SATISFY A PORTION OF THE GENERAL COMPLIANCE REQUIREMENTS.** A photovoltaic credit may be used to reduce the TDV Energy use of a proposed building or addition in order to satisfy the general compliance requirements of this Chapter as follows:~~

~~1. **Low-Rise Residential Buildings.** An application for a new low-rise residential building or an addition to an existing low-rise residential building may use a photovoltaic credit in order to demonstrate compliance with the general compliance requirements of this Chapter only after the TDV Energy of the proposed building or addition, calculated without the photovoltaic credit, is at least 15.0% less than the TDV Energy of the standard building or design.~~

~~2. **High-Rise Residential Buildings.** An application for a new high-rise residential building or an addition to an existing high-rise residential building may use a photovoltaic credit in order to demonstrate compliance with the general compliance requirements of this Chapter only after the TDV Energy of the proposed building or addition, calculated without the photovoltaic credit, is at least 10.0% less than the TDV Energy of the standard building or design.~~

~~3. **Nonresidential Buildings and Hotel/Motel Occupancies.** An application for a new nonresidential building or a new hotel/motel occupancy or an addition to an existing nonresidential building or an existing hotel/motel occupancy may use a photovoltaic credit in order to demonstrate compliance with the general compliance requirements of this Chapter only after the TDV Energy of the proposed building or addition, calculated without the photovoltaic credit, is at least 5.0% less than the TDV Energy of the standard building or design.~~

~~C. **CALCULATION OF PHOTOVOLTAIC CREDIT.**~~

~~1. **Performance Approach Required.** In order to request a photovoltaic credit pursuant to this Section, an applicant for a building permit must use an applicable performance approach methodology specified in Section 22.82.050 to demonstrate compliance with the general compliance requirements of this Chapter.~~

~~2. **Calculation Inputs.** When using the CECPV Calculator to calculate a photovoltaic credit, the permit applicant shall input "Site-Specific Detailed Input" including roof pitch (or tilt), the azimuth and the site shading conditions.~~

~~3. **Documentation.** In order to receive a photovoltaic credit, an applicant for a building permit must include a copy of the CF-1R-PV form generated by the CECPV Calculator on the plans submitted for a building permit.~~

22.82.08070 Expiration.

This Chapter 22.82 shall expire upon the expiration date of the state's 2008 Building Energy Efficiency Standards ~~take effect~~.

Codes and Standards Title 24 Energy-Efficient Local Ordinances

Title: Climate Zone 6 Energy Cost-Effectiveness Study

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1.0 Executive Summary

This report presents the results of Gabel Associates' research, analysis and review of the feasibility and energy cost-effectiveness of building permit applicants exceeding the 2008 Building Energy Efficiency Standards by 15% in Climate Zone 6 in several case studies which reflect a variety of building types.

The study contained in this report may be useful in several ways to local governments who are considering adoption of green building ordinances. First, as a source of information to better understand and discuss the energy cost-effectiveness of exceeding the state's energy standards within a local ordinance; and second, as the cost-effectiveness study that may be included in an application to the California Energy Commission (CEC) by a local government seeking to meet the requirements specified in Section 10-106 of the California Code of Regulations, Title 24, Part 1, Locally Adopted Energy Standards.

The energy requirements of a local green building ordinance are not legally enforceable until the CEC has reviewed and approved the local energy standards as fulfilling all requirements of Section 10-106, the Ordinance has been adopted by the local jurisdiction and has filed with the Building Standards Commission.

The 2008 Building Energy Efficiency Standards, effective January 1, 2010, have been used as the baseline used in calculating the energy performance of efficiency measures summarized in this study.

2.0 Impacts of Exceeding the 2008 Title 24 Standards

The energy performance impacts of exceeding the performance requirements of the 2008 Title 24 Building Energy Efficiency Standards have been evaluated in Climate Zone 6 using several prototypical designs which collectively reflect a broad range of building types, including:

- Single family house: 2-story 2,025 sf
- Single family house: 2-story 4,500 sf
- Low-rise Multi-family building, 8 dwelling units: 2-story 8,442 sf
- High-rise Multi-family building, 40 dwelling units: 4-story 36,800 sf
- Nonresidential office building: 1-story, 10,580 sf
- Nonresidential office building: 5-story, 52,900 sf

The methodology used in the case studies is based on a design process for buildings that meet or exceed the energy standards, and includes the following:

- (a) Each prototype building design is tested for compliance with the 2008 Standards, and the mix of energy measures are adjusted using common construction options so the building first just meets the Standards. The set of energy measures chosen represent a reasonable combination which reflects how designers, builders and developers are likely to achieve a specified level of performance using a relatively low first incremental (additional) cost
- (b) Starting with that set of measures which is minimally compliant with the 2008 Standards, various energy measures are upgraded so that the building just exceeds the 2008 standards by 15%. The design choices by the consultant authoring this study are based on many years of experience with architects, builders, mechanical engineers; and general knowledge of the relative acceptance and preferences of many measures, as well as their incremental costs. This approach tends to reflect how building energy performance is typically evaluated for code compliance and how it's used to select design energy efficiency measures. Note that lowest simple payback with respect to building site energy is not the primary focus of selecting measures; but rather the requisite reduction of Title 24 Time Dependent Valuation(TDV) energy at a reasonable incremental cost consistent with other non-monetary but important design considerations.
- (c) A minimum and maximum range of incremental costs of added energy efficiency measures is established by a variety of research means. A construction cost estimator, Building Advisory LLC, was contracted to conduct research to obtain current measure cost information for many energy measures; and Gabel Associates performed its own additional research to establish first cost data. Site energy in kWh and therms, is calculated from the Title 24 simulation results to establish the annual energy savings, energy cost savings and CO₂-equivalent reductions in greenhouse gases.

2.1 Single Family Homes

The following energy design descriptions of single family building prototypes just meet the 2008 Title 24 Building Energy Efficiency Standards in Climate Zone 6:

CZ6: Single Family House 2,025 square feet, 2-story, 20.2% glazing/floor area ratio

Energy Efficiency Measures
R-38 Roof w/ Radiant Barrier R-13 Walls R-0 Slab on Grade R-30 Raised Floor over Garage/Open at 2nd Floor Low E2 Vinyl Windows, U=0.36, SHGC=0.30 Furnace: 80% AFUE Air Conditioner: None R-8 Attic Ducts 50 Gallon Gas Water Heater: EF=0.62

CZ6: Single Family House 4,500 square feet, 2-story, 22.0% glazing/floor area ratio

Energy Efficiency Measures
R-19 Roof w/o Radiant Barrier R-13 Walls R-19 Raised Floor Low E2 Vinyl Windows, U=0.36, SHGC=0.30 (2) Furnaces: 80% AFUE Air Conditioner: None R-4.2 Attic Ducts (2) Instantaneous Gas Water Heater: RE=0.80

Energy Efficiency Measures Needed to Meet the Ordinance

The following tables list the energy features and/or equipment included in the Title 24 base design, the efficient measure options, and an estimate of the incremental cost for each measure included **to improve the building performance to use 15% less TDV energy than the corresponding Title 24 base case design.**

Incremental Cost Estimate to Exceed Title 24 by 15%
Single Family Prototype: 2,025 SF, Option 1

2025 sf

Climate Zone 6

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Roof w/ Radiant Barrier	-	\$ -	\$ -	\$ -
R-21 Walls (from R-13): 2,550 sf @ \$0.45 to \$0.70/sf	Upgrade	\$ 1,148	\$ 1,785	\$ 1,466
R-0 Slab on Grade	-	\$ -	\$ -	\$ -
R-19 Raised Floor over Garage/Open at 2nd Floor (from R-30): 448 sf @ \$0.25 to \$0.35/sf	Downgrade	\$ (157)	\$ (112)	\$ (134)
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	\$ -	\$ -	\$ -
Furnace: 80% AFUE	-	\$ -	\$ -	\$ -
Air Conditioner: None	-	\$ -	\$ -	\$ -
R-8 Attic Ducts	-	\$ -	\$ -	\$ -
Reduced Duct Leakage/Testing (HERS)	Upgrade	\$ 300	\$ 600	\$ 450
50 Gallon Gas Water Heater: EF=0.62	-	\$ -	\$ -	\$ -
Total Incremental Cost of Energy Efficiency Measures:		\$ 1,291	\$ 2,273	\$ 1,782
Total Incremental Cost per Square Foot:		\$ 0.64	\$ 1.12	\$ 0.88

Incremental Cost Estimate to Exceed Title 24 by 15%
Single Family Prototype: 2,025 SF, Option 2

2025 sf

Climate Zone 6

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-19 Roof w/ Radiant Barrier (from R-38 w/Radiant Barrier): 1,443 sf @ 0.30 to 0.45/sf	Downgrade	\$ (649)	\$ (433)	\$ (541)
R-19 Walls (from R-13): 2,550 sf @ \$0.31 to \$0.54/sf	Upgrade	\$ 791	\$ 1,377	\$ 1,084
R-0 Slab on Grade	-	\$ -	\$ -	\$ -
R-19 Raised Floor over Garage/Open at 2nd Floor (from R-30): 448 sf @ \$0.25 to \$0.35/sf	Downgrade	\$ (157)	\$ (112)	\$ (134)
Quality Insulation Installation (HERS)	Upgrade	\$ 450	\$ 600	\$ 525
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	\$ -	\$ -	\$ -
Furnace: 80% AFUE	-	\$ -	\$ -	\$ -
Air Conditioner: None	-	\$ -	\$ -	\$ -
R-6 Attic Ducts (from R-8)	Downgrade	\$ (325)	\$ (225)	\$ (275)
Reduced Duct Leakage/Testing (HERS)	Upgrade	\$ 300	\$ 600	\$ 450
50 Gallon Gas Water Heater: EF=0.62	-	\$ -	\$ -	\$ -
Pipe Insulation	Upgrade	\$ 150	\$ 200	\$ 175
Total Incremental Cost of Energy Efficiency Measures:		\$ 559	\$ 2,007	\$ 1,283
Total Incremental Cost per Square Foot:		\$ 0.28	\$ 0.99	\$ 0.63

Incremental Cost Estimate to Exceed Title 24 by 15%
Single Family Prototype: 4,500 SF, Option 1

4500 sf

Climate Zone 6

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-30 Roof w/ Radiant Barrier (from R-19 w/o Radiant Barrier): 2,700 sf @ 0.50 to 0.65/sf	Upgrade	\$ 1,350	\$ 1,755	\$ 1,553
R-13 Walls	-	\$ -	\$ -	\$ -
R-19 Raised Floor	-	\$ -	\$ -	\$ -
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	\$ -	\$ -	\$ -
(2) Furnaces: 80% AFUE	-	\$ -	\$ -	\$ -
Air Conditioner: None	-	\$ -	\$ -	\$ -
R-6 Attic Ducts (from R-4.2)	-	\$ -	\$ -	\$ -
Reduced Duct Leakage/Testing (HERS)	Upgrade	\$ 600	\$ 1,200	\$ 900
(2) Instantaneous Gas Water Heater: RE=0.80	-	\$ -	\$ -	\$ -
Pipe Insulation (1705 sf house)	Upgrade	\$ 300	\$ 400	\$ 350
Total Incremental Cost of Energy Efficiency Measures:		\$ 2,250	\$ 3,355	\$ 2,803
Total Incremental Cost per Square Foot:		\$ 0.50	\$ 0.75	\$ 0.62

Incremental Cost Estimate to Exceed Title 24 by 15%
Single Family Prototype: 4,500 SF, Option 2

4500 sf

Climate Zone 6

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-30 Roof w/ Radiant Barrier (from R-19 w/o Radiant Barrier): 2,700 sf @ 0.50 to 0.65/sf	Upgrade	\$ 1,350	\$ 1,755	\$ 1,553
R-15 Walls (from R-13): 2,518 sf @ \$0.14 to \$0.18/sf	Upgrade	\$ 353	\$ 453	\$ 403
R-19 Raised Floor	-	\$ -	\$ -	\$ -
Quality Insulation Installation (HERS)	Upgrade	\$ 450	\$ 600	\$ 525
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	\$ -	\$ -	\$ -
(2) Furnaces: 80% AFUE	-	\$ -	\$ -	\$ -
Air Conditioner: None	-	\$ -	\$ -	\$ -
R-4.2 Attic Ducts	-	\$ -	\$ -	\$ -
(2) Instantaneous Gas Water Heater: RE=0.80	-	\$ -	\$ -	\$ -
Total Incremental Cost of Energy Efficiency Measures:		\$ 2,153	\$ 2,808	\$ 2,480
Total Incremental Cost per Square Foot:		\$ 0.48	\$ 0.62	\$ 0.55

Incremental Cost Estimate to Exceed Title 24 by 15%
Single Family Prototype: 4,500 SF, Option 3

4500 sf

Climate Zone 6

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-19 Roof w/ Radiant Barrier (from R-19 w/o Radiant Barrier): 2,700 sf @ 0.25 to 0.30/sf	Upgrade	\$ 675	\$ 810	\$ 743
R-21 Walls (from R-13): 2,518 sf @ \$0.45 to \$0.50/sf	Upgrade	\$ 1,133	\$ 1,259	\$ 1,196
R-19 Raised Floor	-	\$ -	\$ -	\$ -
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	\$ -	\$ -	\$ -
(2) Furnaces: 80% AFUE	-	\$ -	\$ -	\$ -
Air Conditioner: None	-	\$ -	\$ -	\$ -
R-4.2 Attic Ducts	-	\$ -	\$ -	\$ -
(2) Instantaneous Gas Water Heater: RE=0.82 (from 0.80)	Upgrade	\$ 400	\$ 600	\$ 500
Total Incremental Cost of Energy Efficiency Measures:		\$ 2,208	\$ 2,669	\$ 2,439
Total Incremental Cost per Square Foot:		\$ 0.49	\$ 0.59	\$ 0.54

2.2 Low-rise Multi-family Residential Building

The following is the energy design description of the low-rise multifamily building prototype which just meets the 2008 Title 24 Building Energy Efficiency Standards:

CZ6: Low-rise Multi-family: 2-story 8,442 square feet, 8 units, 12.5% glazing

Energy Efficiency Measures
R-19 Roof w/ Radiant Barrier
R-13 Walls
R-0 Slab on Grade
Low E Vinyl Windows, U=0.40, SHGC=0.36
(8) Furnaces: 80% AFUE
Air Conditioners: None
R-4.2 Attic Ducts
(8) 40 Gallon Gas Water Heaters: EF=0.60

Energy Efficiency Measures Needed to Meet the Ordinance

The following tables list the energy features and/or equipment included in the Title 24 base design, the efficient measure options, and an estimate of the incremental cost for each measure included **to improve the building performance to use 15% less TDV energy than the corresponding Title 24 base case design.**

Climate Zone 6 Energy Measures Needed to Meet the Ordinance

Incremental Cost Estimate to Exceed Title 24 by 15%

Single Family Prototype: 8,442 SF, Option 1

8442 sf

Climate Zone 6

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-30 Roof w/ Radiant Barrier (from R-19 w/Radiant Barrier): 4,221 sf @ 0.25 to 0.35/sf	Upgrade	\$ 1,055	\$ 1,477	\$ 1,266
R-21 Walls (from R-13): 10,146 sf @ \$0.45 to \$0.70/sf	Upgrade	\$ 4,566	\$ 7,102	\$ 5,834
R-0 Slab on Grade	-	\$ -	\$ -	\$ -
Low E Vinyl Windows, U=0.40, SHGC=0.36	-	\$ -	\$ -	\$ -
(8) Furnaces: 80% AFUE	-	\$ -	\$ -	\$ -
Air Conditioners: None	-	\$ -	\$ -	\$ -
R-8 Attic Ducts (from R-4.2)	Upgrade	\$ 2,000	\$ 3,000	\$ 2,500
(8) 40 Gallon Gas Water Heaters: EF=0.63 (from EF=0.60)	Upgrade	\$ 800	\$ 2,000	\$ 1,400
Total Incremental Cost of Energy Efficiency Measures:		\$ 8,421	\$ 13,580	\$ 11,000
Total Incremental Cost per Square Foot:		\$ 1.00	\$ 1.61	\$ 1.30

Incremental Cost Estimate to Exceed Title 24 by 15%

Single Family Prototype: 8,442 SF, Option 2

8442 sf

Climate Zone 6

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-19 Roof w/ Radiant Barrier	-	\$ -	\$ -	\$ -
R-13 Walls	-	\$ -	\$ -	\$ -
R-0 Slab on Grade	-	\$ -	\$ -	\$ -
Dual Clear Vinyl Windows, U=0.50, SHGC=0.60 (from Low E, U=0.40, SHGC=0.36): 1,055 sf @ \$1.40 - \$1.75 / sf	Downgrade	\$ (1,846)	\$ (1,477)	\$ (1,662)
(8) Furnaces: 80% AFUE	-	\$ -	\$ -	\$ -
Air Conditioners: None	-	\$ -	\$ -	\$ -
R-4.2 Attic Ducts	-	\$ -	\$ -	\$ -
(8) Instantaneous Gas Water Heaters: EF=0.79 (from (8) 40 Gallon Gas, 0.60 EF)	Upgrade	\$ 7,600	\$ 13,600	\$ 10,600
Total Incremental Cost of Energy Efficiency Measures:		\$ 5,754	\$ 12,123	\$ 8,938
Total Incremental Cost per Square Foot:		\$ 0.68	\$ 1.44	\$ 1.06

2.3 High-rise Multifamily Building

The following is the energy design description of the high-rise multifamily building prototype which just meets the 2008 Title 24 Building Energy Efficiency Standards:

Title 24 Base Case Design for Options 1 & 2

Energy Efficiency Measures to Meet Title 24
R-26 (4") rigid insulation; Cool Roof Reflectance=0.30, Emittance=0.75
R-19 in Metal Frame Walls
R-4 (1.25") Raised Slab over parking garage
Metal Windows, NFRC U=0.66, SHGC=0.39
PTC 1-ton units: COP=3, EER=11.1
Central DHW boiler: 95% AFUE and recirculating system w/ timer-temperature controls

Title 24 Base Case Design for Option 3

Energy Efficiency Measures to Meet Title 24
R-26 (4") rigid insulation; No Cool Roof
R-19 in Metal Frame Walls
R-2 (5/8") Raised Slab over parking garage
Default Dual Metal Windows, U=0.79, SHGC=0.70
2-pipe fan coil, 80% AFUE boiler, no cooling
Central DHW boiler: 80% AFUE and recirculating system w/ timer-temperature controls

CZ6: High-rise Residential: 4-story 36,800 sf, 40 units, Window Wall Ratio=35.2%

Energy Efficiency Measures Needed to Meet the Ordinance

The following tables list the energy features and/or equipment included in the Title 24 base design, the efficient measure options, and an estimate of the incremental cost for each measure included **to improve the building performance to use 15% less TDV energy than the corresponding Title 24 base case design.**

Incremental Cost Estimate to Exceed Title 24 by 15%
High-rise Residential Prototype: 36,800 SF, Option 1

Climate Zone 6

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-26 (4") rigid insulation; No Cool Roof, 9,200 sf @\$0.30 - \$0.40 sf	Downgrade	\$ (3,174)	\$ (4,232)	\$ (3,703)
R-19 in Metal Frame Walls	-	\$ -	\$ -	\$ -
R-4 (1.25" K-13 spray-on) Raised Slab over parking garage	-	\$ -	\$ -	\$ -
Metal Windows, NFRC U=0.71, SHGCc=0.27; 6,240 sf @ \$0.10 to \$0.35/sf	Upgrade	\$ 920	\$ 3,220	\$ 2,070
PTC 1-ton units: COP=3, EER=11.1	-	\$ -	\$ -	\$ -
Central DHW boiler: 95% AFUE and recirculating system w/ timer-temperature controls	-	\$ -	\$ -	\$ -
Solar Hot Water System, 30% Net Solar Fraction	Upgrade	\$ 40,000	\$ 55,000	\$ 47,500
Total Incremental Cost of Energy Efficiency Measures:		\$ 37,746	\$ 53,988	\$ 45,867
Total Incremental Cost per Square Foot:		\$ 1.03	\$ 1.47	\$ 1.25

Incremental Cost Estimate to Exceed Title 24 by 15%
High-rise Residential Prototype: 36,800 SF, Option 2

Climate Zone 6

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-26 (4") rigid insulation; Cool Roof Refl=0.55, Emitt=0.75 9,200 sf @\$0.15 - \$0.20 sf	Upgrade	\$ 1,380	\$ 1,840	\$ 1,610
R-19 in Metal Frame Walls	-	\$ -	\$ -	\$ -
R-6 (2" K-13 spray-on) Raised Slab over parking garage 9,200 sf @0.70 to \$1.00 sf	Upgrade	\$ 6,440	\$ 9,200	\$ 7,820
Vinyl Super Low-E, NFRC U=0.39, SHGCc=0.23; 6,240 sf @ \$1.40 to \$1.60/sf	Upgrade	\$ 8,736	\$ 9,984	\$ 9,360
PTC 1-ton units: COP=3, EER=11.1	-	\$ -	\$ -	\$ -
Central DHW boiler: 95% AFUE and recirculating system w/ timer-temperature controls	-	\$ -	\$ -	\$ -
Solar Hot Water System, 5% Net Solar Fraction	Upgrade	\$ 8,000	\$ 10,000	\$ 9,000
Total Incremental Cost of Energy Efficiency Measures:		\$ 24,556	\$ 31,024	\$ 27,790
Total Incremental Cost per Square Foot:		\$ 0.67	\$ 0.84	\$ 0.76

Incremental Cost Estimate to Exceed Title 24 by 15%
High-rise Residential Prototype: 36,800 SF, Option 3

Climate Zone 6

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-26 (4") rigid insulation; No Cool Roof	-	\$ -	\$ -	\$ -
R-19 in Metal Frame Walls	-	\$ -	\$ -	\$ -
R-6 (2" K-13 spray-on) Raised Slab over parking garage 9,200 sf @0.70 to \$1.00/sf	-	\$ -	\$ -	\$ -
Metal Low-E, NFRC U=0.66, SHGC=0.39; 6,240 sf @ \$5.00 to \$8.00/sf	Upgrade	\$ 31,200	\$ 49,920	\$ 40,560
PTC 1-ton units: COP=3, EER=11.1	-	\$ -	\$ -	\$ -
Central DHW boiler: 95% AFUE and recirculating system w/ timer- temperature controls	-	\$ -	\$ -	\$ -
Total Incremental Cost of Energy Efficiency Measures:		\$ 31,200	\$ 49,920	\$ 40,560
Total Incremental Cost per Square Foot:		\$ 0.85	\$ 1.36	\$ 1.10

2.4 Nonresidential Buildings

The following energy design descriptions of nonresidential building prototypes just meet the 2008 Title 24 Building Energy Efficiency Standards in Climate Zone 6:

CZ6: Nonresidential 1-story office building: 10,580 sf, Window Wall Ratio= 37.1%

Title 24 Base Case Design, Options 1 and 2

Energy Efficiency Measures to Meet Title 24
R-19 on Metal Span Deck, Cool Roof Refl.=0.69, Emitt=0.75
R-19 in Metal Frame Walls
R-0 (un-insulated) slab-on-grade 1st floor
Dual metal glazing U=0.71 and SHGCc=0.52, 3' overhangs
Lighting = 0.858 w/sf: Open Office Areas: (60) 2-lamp T8 fixtures @58w each; no lighting controls; (24) 18w recessed CFLs. Small Offices: (56 2-lamp T8 fixtures, mandatory (on/off) occupancy sensors; (40) 18w recessed CFLs. Support Areas: (32) 18w recessed CFLs; (48) 13w CFL wall sconces; no controls.
(4) 10-ton Packaged DX units EER=11.0, 4,000 cfm; 80% AFUE furnaces; all standard efficiency fan motors
R-8 duct insulation w/ ducts on the roof
Standard 50 gallon gas water heater, EF=0.58

Title 24 Base Case Design, Option 3

Energy Efficiency Measures to Meet Title 24
R-19 on Metal Span Deck, Cool Roof Refl.=0.69, Emitt=0.75
R-19 in Metal Frame Walls
R-0 (un-insulated) slab-on-grade 1st floor
Dual metal glazing U=0.71 and SHGCc=0.52, 3' overhangs
Lighting = 0.858 w/sf: Open Office Areas: (60) 2-lamp T8 fixtures @58w each; no lighting controls; (24) 18w recessed CFLs. Small Offices: (56 2-lamp T8 fixtures, mandatory (on/off) occupancy sensors; (40) 18w recessed CFLs. Support Areas: (32) 18w recessed CFLs; (48) 13w CFL wall sconces; no controls.
(8) 5-ton Packaged DX units SEER=13.0, 2,000 cfm; 93% AFUE furnaces; all standard efficiency fan motors
R-8 duct insulation w/ ducts on the roof
Standard 50 gallon gas water heater, EF=0.58

Energy Efficiency Measures Needed to Meet the Ordinance

The following tables list the energy features and/or equipment included in the Title 24 base design, the efficient measure options, and an estimate of the incremental cost for each measure included **to improve the building performance to use 15% less TDV energy than the corresponding Title 24 base case design.**

Incremental Cost Estimate to Exceed Title 24 by 15%
Nonresidential Prototype: 10,580 SF, Option 1

Climate Zone 6

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-19 on Metal Span Deck, Cool Roof Refl.=0.69, Emitt=0.75	-	\$ -	\$ -	\$ -
R-19 in Metal Frame Walls	-	\$ -	\$ -	\$ -
R-0 (un-insulated) slab-on-grade 1st floor	-	\$ -	\$ -	\$ -
Dual metal glazing U=0.71 and SHGCc=0.27, 3' overhangs 3,200 sf @ \$2.50 to \$3.50/sf	Upgrade	\$ 8,000	\$ 11,200	\$ 9,600
Lighting = 0.858 w/sf: Open Office Areas: (60) 2-lamp T8 fixtures @58w each; no lighting controls; (24) 18w recessed CFLs. Small Offices: (56) 2-lamp T8 fixtures, mandatory (on/off) occupancy sensors; (40) 18w recessed CFLs. Support Areas: (32) 18w recessed CFLs; (48) 13w CFL wall sconces; no controls.	-	\$ -	\$ -	\$ -
(4) 10-ton Packaged DX units EER=11.0, 4,000 cfm; 80% AFUE furnaces; all standard efficiency fan motors	-	\$ -	\$ -	\$ -
R-8 duct insulation w/ ducts on roof: sealed w/ HERS testing	Upgrade	\$ 2,000	\$ 3,000	\$ 2,500
Standard 50 gallon gas water heater, EF=0.58	-	\$ -	\$ -	\$ -
Total Incremental Cost of Energy Efficiency Measures:		\$ 10,000	\$ 14,200	\$ 12,100
Total Incremental Cost per Square Foot:		\$ 0.95	\$ 1.34	\$ 1.14

Incremental Cost Estimate to Exceed Title 24 by 15%
Nonresidential Prototype: 10,580 SF, Option 2

Climate Zone 6

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-24 on Metal Span Deck, Cool Roof Refl.=0.69, Emitt=0.75	-	\$ -	\$ -	\$ -
R-19 in Metal Frame Walls	-	\$ -	\$ -	\$ -
R-0 (un-insulated) slab-on-grade 1st floor	-	\$ -	\$ -	\$ -
Dual metal glazing U=0.71 and SHGCc=0.27, 3' overhangs 3,200 sf @ \$2.50 to \$3.50/sf	Upgrade	\$ 8,000	\$ 11,200	\$ 9,600
Lighting = 0.858 w/sf: Open Office Areas: (60) 2-lamp T8 fixtures @58w each; no lighting controls; (24) 18w recessed CFLs. Small Offices: (56) 2-lamp T8 fixtures, (28) multi-level occupancy sensors @ \$75 to \$100 each; (40) 18w recessed CFLs. Support Areas: (32) 18w recessed CFLs; (48) 13w CFL wall sconces; no controls.	Upgrade	\$ 2,100	\$ 2,800	\$ 2,450
(4) 10-ton Packaged DX units EER=11.0, 4,000 cfm; 80% AFUE furnaces; all standard efficiency fan motors	-	\$ -	\$ -	\$ -
R-8 duct insulation w/ ducts on the roof	-	\$ -	\$ -	\$ -
Standard 50 gallon gas water heater, EF=0.58	-	\$ -	\$ -	\$ -
Total Incremental Cost of Energy Efficiency Measures:		\$ 10,100	\$ 14,000	\$ 12,050
Total Incremental Cost per Square Foot:		\$ 0.95	\$ 1.32	\$ 1.14

Incremental Cost Estimate to Exceed Title 24 by 15%
Nonresidential Prototype: 10,580 SF, Option 3

Climate Zone 6

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-24 on Metal Span Deck, Cool Roof Refl.=0.69, Emitt=0.75	-	\$ -	\$ -	\$ -
R-19 in Metal Frame Walls	-	\$ -	\$ -	\$ -
R-0 (un-insulated) slab-on-grade 1st floor	-	\$ -	\$ -	\$ -
Dual metal glazing U=0.71 and SHGC=0.40, 3' overhangs 3,200 sf @ \$1.50 to \$2.50/sf	Upgrade	\$ 4,800	\$ 8,000	\$ 6,400
Lighting = 0.858 w/sf: Open Office Areas: (60) 2-lamp T8 fixtures @58w each; no lighting controls; (24) 18w recessed CFLs. Small Offices: (56) 2-lamp T8 fixtures, mandatory (on/off) occupancy sensors; (40) 18w recessed CFLs. Support Areas: (32) 18w recessed CFLs; (48) 13w CFL wall sconces; no controls.	-	\$ -	\$ -	\$ -
(8) 5-ton Packaged DX units SEER=13.0, 2,000 cfm; 93% AFUE furnaces; fixed-temp integrated air-economizers	-	\$ 3,600	\$ 4,800	\$ 4,200
R-8 duct insulation w/ ducts on roof: sealed w/ HERS testing	Upgrade	\$ 2,000	\$ 3,000	\$ 2,500
Standard 50 gallon gas water heater, EF=0.58	-	\$ -	\$ -	\$ -
Total Incremental Cost of Energy Efficiency Measures:		\$ 10,400	\$ 15,800	\$ 13,100
Total Incremental Cost per Square Foot:		\$ 0.98	\$ 1.49	\$ 1.24

CZ6: Nonresidential 5-story office building: 52,900 sf, Window Wall Ratio= 29.1%

Title 24 Base Case Design, Option 1

Energy Efficiency Measures to Meet Title 24
R-19 on Metal Deck; cool roof Reflect=0.55, Emittance=0.75
R-19 in Metal Frame Walls
R-0 (un-insulated) slab-on-grade 1st floor
NFRC glazing U=0.57, SHGC=0.407 (COG SHGC=0.38)
Lighting = 0.802 w/sf: Open Office Areas: (300) 2-lamp T8 fixtures @58w each; no lighting controls; (120) 18w recessed CFLs. Small Offices: (280) 2-lamp T8 fixtures, (140) multi-level occupancy sensors on T8s; (200) 18w recessed CFLs. Support Areas: (160) 18w recessed CFLs; (240) 13w CFL wall sconces; no controls.
(5) 40-ton Packaged VAV units EER=9.5; 78% TE furnaces; standard efficiency fan motors; 20% VAV boxes w/ electric reheat; DDC controls; differential temp. integrated air economizers
R-8 duct insulation w/ ducts in conditioned
(5) Instantaneous Electric Water Heaters EF=0.92

Title 24 Base Case Design, Option 2

Energy Efficiency Measures to Meet Title 24
R-19 on Metal Deck; cool roof Reflect=0.55, Emittance=0.75
R-19 in Metal Frame Walls
R-0 (un-insulated) slab-on-grade 1st floor
NFRC glazing U=0.57, SHGC=0.407 (COG SHGC=0.38)
Lighting = 0.802 w/sf: Open Office Areas: (300) 2-lamp T8 fixtures @58w each; no lighting controls; (120) 18w recessed CFLs. Small Offices: (280) 2-lamp T8 fixtures, (140) multi-level occupancy sensors on T8s; (200) 18w recessed CFLs. Support Areas: (160) 18w recessed CFLs; (240) 13w CFL wall sconces; no controls.
(5) 40-ton Packaged VAV units EER=9.5; 78% TE furnaces; standard efficiency fan motors; 20% VAV boxes w/ hot water reheat; DDC controls; differential temp. integrated air economizers
R-8 duct insulation w/ ducts in conditioned
(5) Instantaneous Electric Water Heaters EF=0.92

Title 24 Base Case Design, Option 3

Energy Efficiency Measures to Meet Title 24
R-26 on Metal Deck, no cool roof
R-19 in Metal Frame Walls
R-0 (un-insulated) slab-on-grade 1st floor
NFRC glazing U=0.57, SHGC=0.544 (COG SHGC=0.54)
Lighting = 0.802 w/sf: Open Office Areas: (300) 2-lamp T8 fixtures @58w each; no lighting controls; (120) 18w recessed CFLs. Small Offices: (280) 2-lamp T8 fixtures, mandatory (on/off) occupancy sensors on T8s; (200) 18w recessed CFLs. Support Areas: (160) 18w recessed CFLs; (240) 13w CFL wall sconces; no controls.
Built-up VAV system, 80% boiler, 180-ton screw chiller 1.2 kw/ton, one AHU per floor, standard efficiency VSD fan motors; 20% VAV boxes w/ hot water reheat; DDC controls; differential temp. integrated air economizers
R-8 duct insulation w/ ducts in conditioned
(5) Instantaneous Electric Water Heaters EF=0.92

Incremental Cost Estimate to Exceed Title 24 by 15%
Nonresidential Prototype: 52,900 SF, Option 1

Climate Zone 6

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-26 on Metal Deck; cool roof Reflect=0.70, Emittance=0.75 10,580 sf @ \$0.90 to \$1.60/sf	Upgrade	\$ 9,522	\$ 16,928	\$ 13,225
R-19 in Metal Frame Walls	-	\$ -	\$ -	\$ -
R-0 (un-insulated) slab-on-grade 1st floor	-	\$ -	\$ -	\$ -
NFRC glazing U=0.573, SHGC=0.312 (COG SHGC=0.27) 16,000 sf @ \$1.00 to \$2.00/sf	Upgrade	\$ 16,000	\$ 32,000	\$ 24,000
Lighting = 0.696 w/sf: Open Office Areas: (160) HO 2-lamp T8 fixtures @74w each; no lighting controls; (120) 18w recessed CFLs. Small Offices: (280) 2-lamp T8 fixtures, (140) multi-level occupancy sensors on T8s; (200) 18w recessed CFLs. Support Areas: (160) 18w recessed CFLs; (240) 13w CFL wall sconces; no controls. Net saving of \$36 to \$40 per new fixture in open offices because of a total reduction of 46% of T8 fixtures in these areas	Upgrade	\$ (5,760)	\$ (6,400)	\$ (6,080)
(5) 40-ton Packaged VAV units EER=9.5; 78% TE furnaces; Premium efficiency fan motors; 20% VAV boxes w/ hot water reheat; DDC controls; differential temp. integrated air economizers	Upgrade	\$ 54,400	\$ 81,350	\$ 67,875
R-8 duct insulation w/ ducts in conditioned	-	\$ -	\$ -	\$ -
92% RE boiler for service hot water	Upgrade	\$ 8,000	\$ 12,000	\$ 10,000
Total Incremental Cost of Energy Efficiency Measures:		\$ 82,162	\$ 135,878	\$ 109,020
Total Incremental Cost per Square Foot:		\$ 1.55	\$ 2.57	\$ 2.06

Incremental Cost Estimate to Exceed Title 24 by 15%
Nonresidential Prototype: 52,900 SF, Option 2

Climate Zone 6

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-26 on Metal Deck; cool roof Reflect=0.72, Emittance=0.75 10,580 sf @ \$0.90 to \$1.60/sf	Upgrade	\$ 9,522	\$ 16,928	\$ 13,225
R-19 in Metal Frame Walls	-	\$ -	\$ -	\$ -
R-0 (un-insulated) slab-on-grade 1st floor	-	\$ -	\$ -	\$ -
NFRC glazing U=0.54, SHGC=0.30 (COG SHGC=0.27) 16,000 sf @ \$3.00 to \$4.00/sf	Upgrade	\$ 48,000	\$ 64,000	\$ 56,000
Lighting = 0.696 w/sf: Open Office Areas: (160) HO 2-lamp T8 fixtures @74w each; no lighting controls; (120) 18w recessed CFLs. Small Offices: (280) 2-lamp T8 fixtures, (140) multi-level occupancy sensors on T8s; (200) 18w recessed CFLs. Support Areas: (160) 18w recessed CFLs; (240) 13w CFL wall sconces; no controls. Net saving of \$38 to \$42 per new fixture in open offices because of a total reduction of 46% of T8 fixtures in these areas	Upgrade	\$ (5,760)	\$ (6,400)	\$ (6,080)
(5) 40-ton Packaged VAV units EER=9.5; 78% TE furnaces; Premium efficiency fan motors; 20% VAV boxes w/ hot water reheat; DDC controls; differential temp. integrated air economizers	Upgrade	\$ 1,500	\$ 2,500	\$ 2,000
R-8 duct insulation w/ ducts in conditioned	-	\$ -	\$ -	\$ -
92% RE boiler for service hot water	Upgrade	\$ 8,000	\$ 12,000	\$ 10,000
Total Incremental Cost of Energy Efficiency Measures:		\$ 61,262	\$ 89,028	\$ 75,145
Total Incremental Cost per Square Foot:		\$ 1.16	\$ 1.68	\$ 1.42

Incremental Cost Estimate to Exceed Title 24 by 15%
Nonresidential Prototype: 52,900 SF, Option 3

Climate Zone 6

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-26 on Metal Deck, no cool roof	-	\$ -	\$ -	\$ -
R-19 in Metal Frame Walls	-	\$ -	\$ -	\$ -
R-0 (un-insulated) slab-on-grade 1st floor	-	\$ -	\$ -	\$ -
NFRC glazing U=0.57, SHGC=0.312 (COG SHGC=0.27) 16,000 sf @ \$1.50 to \$2.50/sf	Upgrade	\$ 24,000	\$ 40,000	\$ 32,000
Lighting = 0.797 w/sf: Open Office Areas: (300) 2-lamp T8 fixtures @58w each; no lighting controls; (120) 18w recessed CFLs. Small Offices: (280) 2-lamp T8 fixtures, (140) multi-level occupancy sensors on T8s @ \$75 to \$100 each; (200) 18w recessed CFLs. Support Areas: (160) 18w recessed CFLs; (240) 13w CFL wall sconces; no controls.	Upgrade	\$ 10,500	\$ 14,000	\$ 12,250
Built-up VAV system, 80% boiler, 180-ton screw chiller 1.2 kw/ton, one AHU per floor, standard efficiency VSD fan motors; 20% VAV boxes w/ hot water reheat; DDC controls; differential temp. integrated air economizers	-	\$ -	\$ -	\$ -
R-8 duct insulation w/ ducts in conditioned	-	\$ -	\$ -	\$ -
DHW from 80% RE boiler used for space heating	Upgrade	\$ 6,000	\$ 10,000	\$ 8,000
Total Incremental Cost of Energy Efficiency Measures:		\$ 40,500	\$ 64,000	\$ 52,250
Total Incremental Cost per Square Foot:		\$ 0.77	\$ 1.21	\$ 0.99

3.0 Cost Effectiveness

The summary of results in this section are based upon the following assumptions:

- Annual site electricity (kWh) and natural gas (therms) saved are calculated using a beta version of the state-approved energy compliance software for the 2008 Building Energy Efficiency Standards, Micropas 8.
- Average residential utility rates of \$0.159/kWh for electricity and \$0.94/therm for natural gas in current constant dollars; nonresidential rates are time-of-use rate schedules modeled explicitly in the DOE-2.1E computer simulation: Southern California Edison GS-1 schedule for electricity and Southern California Gas GN-10 schedule for natural gas.
- No change (i.e., no inflation or deflation) of utility rates in constant dollars
- No increase in summer temperatures from global climate change

The Simple Payback data includes a cost-effectiveness analysis of the Ordinance with respect to each case study building design and assumes:

- No external cost of global climate change -- and corresponding value of additional investment in energy efficiency and CO₂ reduction – is included
- The cost of money (e.g, opportunity cost) invested in the incremental cost of energy efficiency measures is not included.

3.1 New Single Family Houses

Climate Zone 6: 15% Better Than Title 24

Single Family

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost (\$)	Annual Energy Cost Savings (\$)	Simple Payback (Years)
2,025 sf (Option 1)	87	49	\$1,782	\$60	29.8
2,025 sf (Option 2)	81	50	\$1,283	\$60	21.4
Averages:	84	50	\$1,533	\$60	25.6

Annual Reduction in CO2-equivalent: 618 lb./building-year
0.30 lb./sq.ft.-year

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost (\$)	Annual Energy Cost Savings (\$)	Simple Payback (Years)
4,500 sf (Option 1)	194	44	\$2,803	\$72	38.8
4,500 sf (Option 2)	207	43	\$2,481	\$73	33.8
4,500 sf (Option 3)	189	45	\$2,439	\$72	33.7
Averages:	197	44	\$2,574	\$73	35.4

Annual Reduction in CO2-equivalent: 601 lb./building-year
0.13 lb./sq.ft.-year

3.2 Low-rise Multi-family Building

Climate Zone 6: 15% Better Than Title 24

Low-rise Apartments

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost (\$)	Annual Energy Cost Savings (\$)	Simple Payback (Years)
8-Unit, 8,442 sf (Option 1)	470	227	\$11,001	\$288	38.2
8-Unit, 8,442 sf (Option 2)	-1221	483	\$8,939	\$260	34.4
Averages:	-376	355	\$9,970	\$274	36.3

Annual Reduction in CO2-equivalent: 3,963 lb./building-year
0.47 lb./sq.ft.-year

3.3 High-rise Multi-family Building

Climate Zone 6: 15% Better Than Title 24

High-rise Apartments

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost (\$)	Annual Energy Cost Savings (\$)	Simple Payback (Years)
36,800 sf (Option 1)	1655	1110	\$45,867	\$1,307	35.1
36,800 sf (Option 2)	4800	555	\$27,790	\$1,285	21.6
36,800 sf (Option 3)	27657	-658	\$40,560	\$3,779	10.7
Averages:	11371	336	\$38,072	\$2,123	22.5

*Annual Reduction in CO2-equivalent: 11143 lb./building-year
0.30 lb./sq.ft.-year*

3.4 Nonresidential Buildings

Climate Zone 6: 15% Better Than Title 24

1-Story Office Building

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost (\$)	Annual Energy Cost Savings (\$)	Simple Payback (Years)
10,580 sf (Option 1)	13427	-53	\$12,100	\$2,957	4.1
10,580 sf (Option 2)	5481	356	\$12,050	\$1,400	8.6
10,580 sf (Option 3)	12307	17	\$13,100	\$1,026	12.8
Averages:	10405	107	\$12,417	\$1,794	8.5

*Annual Reduction in CO2-equivalent: 5,924 lb./building-year
0.56 lb./sq.ft.-year*

Climate Zone 6: 15% Better Than Title 24

5-Story Office Building

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost (\$)	Annual Energy Cost Savings (\$)	Simple Payback (Years)
52,900 sf (Option 1)	87180	-3439	\$109,020	\$17,289	6.3
52,900 sf (Option 2)	75234	-2433	\$75,145	\$15,720	4.8
52,900 sf (Option 3)	99931	-2733	\$52,250	\$21,244	2.5
Averages:	87448	-2868	\$78,805	\$18,084	4.5

*Annual Reduction in CO2-equivalent: 5,964 lb./building-year
0.11 lb./sq.ft.-year*

Conclusions

Regardless of the building design, occupancy profile and number of stories, the incremental improvement in overall annual energy performance of buildings in exceeding the 2008 Title 24 Building Energy Efficiency Standards appears cost-effective. However, each building's overall design, occupancy type and specific design choices may allow for a large range of incremental first cost and payback. As with simply meeting the requirements of the Title 24 energy standards, a permit applicant complying with the additional energy requirements of a local green building ordinance should carefully analyze building energy performance to reduce incremental first cost and the payback for the required additional energy efficiency measures.